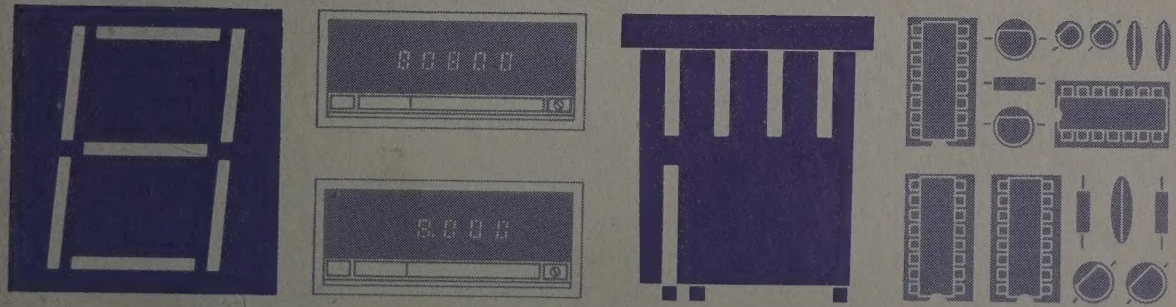
WESTERN MICRO

Model 5900 Series

portable thermometer



DigiTec Instrumentation

WARNING

This instrument is designed to prevent accidental shock to operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to do so can result in a serious or fatal accident.

SHOCK HAZARD (As defined in Underwriters Laboratories Radio and Television Receiving Appliances Standards for Safety, Twelfth Edition, dated June 25, 1969.)

"Shock hazard shall be considered to exist at any part involving a potential of between 42.4 volts peak and 40 kilovolts peak in the following cases:

A. If the current through a load of not less than 500 ohms exceeds 300 milliamperes after 0.0003 second.

B. If the current through a load of not less than 500 ohms exceeds 5 milliamperes after 0.2 second.

C. If the time required for the current through a load of not less than 500 ohms to decrease to .5 milliamperes is between 0.1 and 0.2 second, and the total quantity of electricity passed through the load up to that time exceeds 4 millicoulombs.

D. If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.03 and 0.1 second, and the total quantity of electricity passed through the load up to that time exceeds $75T\text{-}350T^2$ millicoulombs, where T is the time in seconds.

E. If the potential is more than 5 kilovolts peak and if the total capacitance of the circuit is more than 3000 micromicrofarads.

NOTE: Additional factors might apply when potentials more than 40 kilovolts peak are present.

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SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

WELCOME

Welcome — From United Systems Corporation. Thank you for choosing one of the DigiTec 5900 Series portable, digital thermometers. Your continued satisfaction with DigiTec products is important to us; so this manual has been prepared to promote a clear understanding of the instrument, its capabilities and its proper use. Please follow these instructions to ensure optimum performance from, and your continued satisfaction with, your 5900 Series portable thermometer.

UNPACKING AND INSPECTION

Examine the shipping carton and the thermometer for any evidence of damage to the instrument. If there is any indication of damage, file a complaint immediately with the carrier.

Save the shipping carton and packing materials for future storing or shipping of the instrument.

If the instrument must be returned, contact the factory for prior approval. Give a full explanation of the reason and, if a malfunction is involved, the mode of operation in which it occurred. Upon receipt of approval, ship it in the original carton (or otherwise sufficiently packaged to prevent damage in shipment) PREPAID to the factory or your nearest authorized service center.

Should there be no sign of damage, proceed with the instructions in this manual. Read the SHOCK HAZARD warning on the inside of the front cover to avoid injury due to electrical shock.

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1. INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 5900 Series portable, digital thermometer is designed for temperature-measurement applications in which either the broad temperature range of a thermocouple or the high stability of a platinum resistance RTD is important. You will find the same emphasis on reliability and performance that people depend on in DigiTec instruments, and the close attention to human engineering that makes the instruments so easy to use.

The Model 5900 Series portable thermometer comes in an attractive but rugged, designer-styled case that is convenient to handle. Simply plug in your probe, push the power switch and you're ready to go. The thermometer can be operated on its built-in rechargeable battery or an ac power line through its plug-in charger. And the standard LCD display is easy to read. It requires only a small amount of current to operate and provides long, continuous use of the thermometer before it's necessary to recharge the battery.

1.2 FEATURES

These outstanding features highlight the main characteristics of the Model 5900 Series portable thermometers:

- Thermocouple/platinum resistance input
- 1° resolution and repeatability
- 3-1/2 digit LCD display (LED optional)
- Rechargeable built-in battery, and ac operation through a plug-in charger
- °C or °F depending on model selected
- Internal ice-point compensation

1.3 GENERAL SPECIFICATIONS

The following tables contain the general technical specifications of the Model 5900 Series portable thermometers.

COMMON SPECIFICATIONS			
Resolution & Repeatability		1°C or F	
Ice-Point Conformity		±0.025°C/°C	
Probe Lead Break		Displays a random out-of-range value	
Power Requirements		Built-in battery or 115/230V ac, 50/60 Hz through in-line charger #89-17395	
Display Type		LCD, 0.5" high	LED, 0.4" high
Battery Capacity		16 hrs. nominal continuous operation	7 hrs. nominal continuous operation
		16 hrs. recharge from full discharge	
Operating Ambient		5°C to 45°C	0°C to 50°C
Temperature Coefficient		±0.15°/°C: Thermocouple ±0.1°/°C: Platinum Resistance	
Response Time		<2 Sec: Thermocouple <900 mS: Platinum Resistance	
Sample Rate		3 per second, nominal	
Polarity Indication		Automatic	
Analog Output (Optional)	Voltage	-6.4 mV/°C or F	
	Impedance	100Ω	
Dimensions		2.43"H x 7.25"W x 7.93"D (5.9 cm x 18.75 cm x 20.1 cm)	
Weight		Net: 2 lbs (0.9 kg) Shipping: 4 lbs (1.8 kg)	

MODEL 5900 SERIES PORTABLE THERMOMETERS

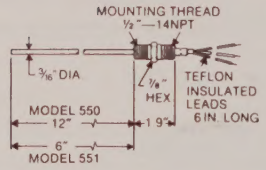
THERMOCOUPLE						
Scale	Model	Sensor Type	Range	Conformity*	Analog Output Option	
					Voltage +3%	Impedance
°C	5900-JC	J	-180° to +760°	±0.7°C	12mV/°C	100Ω
	5900-TC	T	-152° to +400°		23mV/°C	
	5900-EC	E	-98° to +1000°		9.3mV/°C	
	5900-KC	K	-58° to +1372°	±1.0°C	7.5mV/°C	
°F	5900-JF	J	-292° to +1400°	±1.3°F	6.5mV/°F	
	5900-TF	T	-240° to +752°		12.3mV/°F	
	5900-EF	E	-144° to +1832°		5mV/°F	
	5900-KF	K	-72° to +1999°	±1.7°F	4mV/°F	

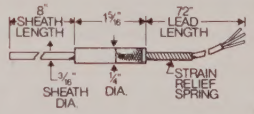
*Conformity @ 23°C ±3°, <85% r.h., ±1 least significant digit.
Conforms to NBS 125 Table.

PLATINUM RESISTANCE						
Scale	Model	Sensor Type	Range	Conformity*	Analog Output Option	
					Voltage +1%	Impedance
°C	5900-PC	PT-100 $\alpha = 0.00385$	-100° to +600°	±0.3°C (-100° to +400°C) ±0.6°C (400° to 500°C) ±1.7°C (500° to 600°C)	1mV/°C	100Ω
°F	5900-PF	PT-100 $\alpha = 0.00385$	-148° to 1112°	±0.5°F (-148° to +752°F) ±0.8°F (752° to +932°F) ±3.0°F (932° to 1112°F)	1mV/°F	

*Conformity @ 23°C ±3°, <85% r.h., ±1 least significant digit.

MODEL 550 SERIES
PLATINUM RESISTANCE PROBES





GENERAL SPECIFICATIONS 550 SERIES PROBES	
RANGE	-100°C to + 600°C (-148°F to +1112°F)
BASE RESISTANCE (32°F)	100 (±0.1) Ohms at 0°C
LONG TERM STABILITY	0.25°C (0.45°F)
TIME CONSTANT*	2.5 Seconds
ACCURACY, INTERCHANGEABLE	±0.25°C or ±0.33% of reading; whichever is greater
ACCURACY, OPTION "X"	±0.1°C
EXTERNAL MATERIAL	Iconel™ sheathing
ELECTRICAL CONNECTION	3 wire leads
PRESSURE RATING	100 psi
SELF HEATING EFFECT	Negligible when used with DigiTec thermometers

*Time required to reach 63% of a step change (in well stirred water bath).

1.4 OPTIONS AND ACCESSORIES

These options and accessories enhance the basic features of the Model 5900 Series portable thermometers:

- ANALOG OUTPUT — this useful option provides an analog version of the measured signal for driving a peripheral strip-chart recorder. The 100 ohm output impedance of this analog output satisfies most strip-chart recorder input requirements and simplifies interfacing procedures.

- CARRYING CASE — a leather case protects the instruments and provides storage space for the probes, line cord, spare fuses and instruction manual. The thermometer may be operated while in the case.

- 550 SERIES PLATINUM RESISTANCE PROBES — three different models of platinum resistance probes provide a good selection for the greatest level of accuracy, stability and resolution.

  MODEL 550, Interchangeable Type (12" long)
  MODEL 551, Interchangeable Type (6" long)
  Individually Calibrated, Option X
  Handle with Flexible 8 Ft. Cable, Option H

1.5 TECHNICAL ASSISTANCE

United Systems Corporation offers assistance, if necessary, in solving application problems. We also encourage inquiries concerning special applications and custom-designed systems.

2. PANEL FUNCTIONS

FRONT PANEL

(1) DISPLAY — visually indicates the temperature measurement in either °C or °F depending on the particular model of thermometer. LCD display is standard for normal light conditions; LED display is optional for low light level conditions.

(2) ON/OFF BUTTON — is the power switch for the instrument.

REAR PANEL

(3) PROBE INPUT — provides an input jack to connect a thermocouple probe, or binding posts to connect a platinum resistance probe (depends on model selected).

(4) CHARGER INPUT — provides an input jack to connect the in-line charger for battery charging and ac operation.

(5) RECORDER OUTPUT — provides an output jack for the Analog Output operation.

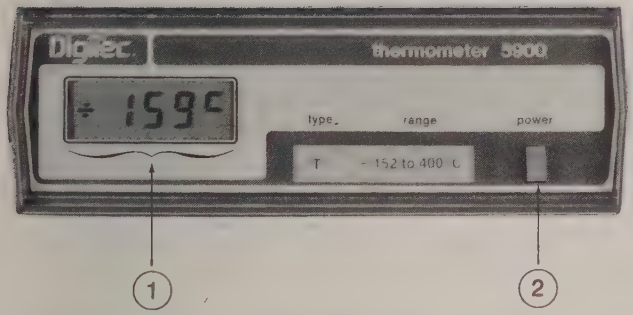


Figure 1. Model 5900 Front Panel

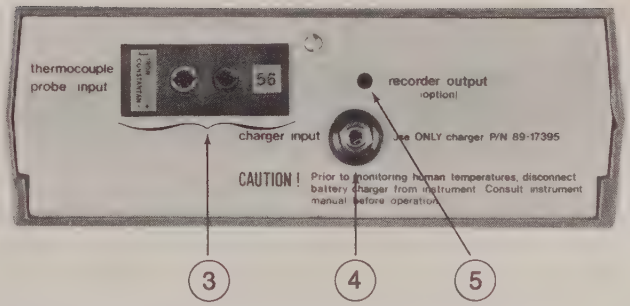


Figure 2. Thermocouple Models Rear Panel

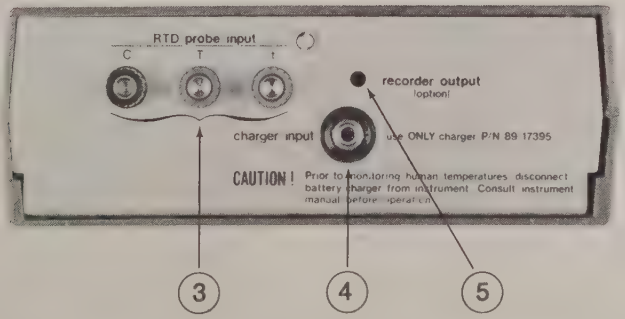


Figure 3. RTD Models Rear Panel

3. POWER AND WARM-UP

The Model 5900 Series thermometer may be powered by its internal battery or by an ac power line through the supplied in-line charger only (P/N 89-17395). A slide switch on the charger is provided for matching its intput to the ac power line voltage — either 115 or 230.

CAUTION

Do NOT monitor HUMAN temperature with the in-line charger connected to the thermometer. Use battery power to avoid a shock hazard.

The instrument may be operated immediately after turning on, but maximum stability is attained after a five-minute warm-up.

►NOTE: *Before the thermometer is used for the first time, or any time it has been idle for an extended period, connect it to ac power and charge the battery for approximately 15 minutes.*

3.1 BATTERY OPERATION

The Model 5900 may be powered by its internal battery by disconnecting the in-line charger from the instrument.

The battery is charged by connecting the in-line charger (P/N 89-17395) to the CHARGER INPUT jack on the rear panel of the thermometer. Make sure the slide switch on the plug side of the charger is set to match the ac power line voltage (115 or 230), and then plug the charger into the ac outlet. The battery will automatically charge at its maximum rate. A full charge from a complete discharge takes approximately 16 hours with the instrument turned off.

The thermometer may be turned on and used while the battery is charging (except when monitoring human temperature), but the charge time will increase due to drain on the battery.

A maximum charge in the battery will typically provide 16 hours continuous operation if the thermometer has the standard LCD display and 7 hours continuous operation if the unit has the optional LED display.

IMPORTANT

The thermometer will automatically indicate when its battery voltage drops too low to maintain proper operation: in LCD display models, the display will completely blank; in LED display models, the display will blank except for the polarity sign, "1" digit, decimal point and temperature symbol. If this happens, simply plug in the in-line charger and let the battery charge. To continue operation on ac power, turn the instrument's power switch off and back on again.

3.2 AC OPERATION

The Model 5900 Series thermometer may be operated on 115V or 230V ac to conserve the battery (except when monitoring human temperature). Connect the in-line

charger to the CHARGER INPUT jack on the rear panel of the thermometer. Make sure the slide switch on the plug side of the charger is set to match the ac power line voltage (115 or 230), and then plug the charger into the ac outlet. Use only the in-line charger supplied with the instrument (P/N 89-17395).

3.3 FUSE CHANGING

The fuse is located on the main circuit board inside the Model 5900 thermometer. If the fuse needs to be changed, it should be replaced by a 1/2 amp, 250 volt fuse.

The following procedure explains how to change the fuse:

1) Remove the two panhead screws as indicated on the instruction panel on the bottom of the thermometer.
2) Make sure the tilt bail is out of the way of the front of the instrument.
3) Slide the front panel/main board assembly out the front of the case by pushing on the rear panel. The fuse is located in the left-hand corner of the main circuit board as it's facing you. See Figure 4.
4) Pry the old fuse from the spring clip terminals.
5) Snap the new fuse (1/2A, 250V) into the spring clip terminals.
6) Push the front panel/main board assembly back into the case.
7) Fasten the front panel/main board assembly in the case with the two panhead screws.

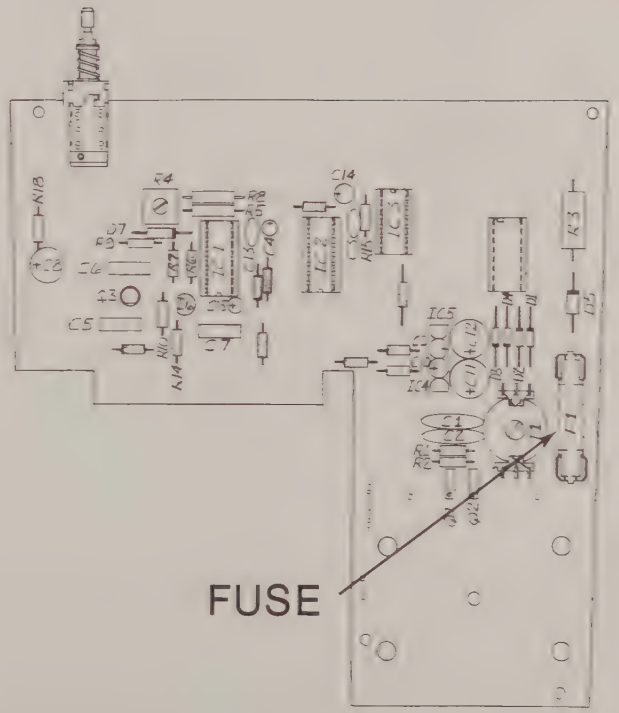


Figure 4. Fuse Location

4. PROBE CONNECTION

CAUTION

When the Model 5900 thermometer is equipped with the optional Analog Output, the PROBE'S COMMON (Negative) lead is internally connected to the instrument's rear panel. This could cause a shock hazard at the probe if the rear panel of the thermometer should contact something that is power line hot.

4.1 THERMOCOUPLE MODELS

On the Model 5900 thermocouple thermometer, insert the double-prong plug end of the probe assembly into the PROBE INPUT jack on the rear panel of the instrument. Each specific type of thermocouple has its own particular connector.

► NOTE: *Be SURE the plug is pushed in COMPLETELY against the input jack. If it is not completely inserted, the temperature reading may NOT be correct.*

If the probe or a lead wire ever becomes open or disconnected, the thermometer will display a negative, out-of-range number.

4.2 PLATINUM RESISTANCE MODELS

On the Model 5900 platinum resistance thermometer, connect the three probe leads to the three rear-panel, five-way binding posts. Each post is labeled to identify the proper connection.

If the probe or a lead wire ever becomes open or disconnected, the thermometer will display either a positive or a negative out-of-range number.

5. ICE-POINT COMPENSATION

Thermocouple circuit operation is based on the principle that two dissimilar metals joined together produce a voltage which is a function of the temperature at their junction. When a complete circuit is formed by connecting two dissimilar metal wires in parallel, there are two such junctions (one at each end of the pair of wires) which produce thermal voltages that oppose each other. With the temperature of one of the junctions higher than the other, a current will flow in the circuit and will continue to flow as long as the two junctions are at different temperatures. The total thermal voltage producing this current is proportional to the difference in temperature between the two junctions.

A practical thermocouple circuit consists of a "hot" MEASURING junction (the probe) and a "cold" REFERENCE junction (the connection between the thermocouple wires and the meter input terminals or copper extension wires). Temperature is measured according to the DIFFERENCE in temperature between the hot and the cold junctions; so the cold junction must be used as a reference by keeping its thermal voltage CONSTANT and at a value equivalent to the desired zero-point temperature. This can be done by keeping the cold junction at a constant temperature (usually in an ice bath at 0°C) or, more conveniently, by connecting an electrical compensating circuit to nullify voltage variations in the reference caused by ambient temperature changes at

the cold junction. Then a specific offset voltage may be calibrated at the cold junction to place it at the desired equivalent zero reference value.

The ice-point compensation transistor or thermistor is a vital part of the compensating circuit. It must be placed at the same location as the cold reference junction because it must "sense" ambient temperature changes at the junction and nullify them.

In the Model 5900 Series portable thermocouple thermometer, the ice-point compensation transistor is located inside the thermocouple probe input jack.

6. TEMPERATURE MEASUREMENT SYSTEM ACCURACY

In a complete thermocouple or platinum resistance temperature measurement system, there are three basic factors that may affect the total accuracy of the measurement: the instrument, the probe and the probe lead wires.

The total accuracy of the measuring system consisting of the probe, the probe lead wires and the instrument may be expressed in two different ways: (1) Worst Case Error or (2) Typical Error. The following equations define the two different terms:

Where: A = Instrument Error
B = Probe Error
C = Probe Lead Error

Then: (1) Worst Case Error $= \pm (|A| + |B| + |C|)$

(2) Typical Error: $= \pm \sqrt{A^2 + B^2 + C^2}$

Errors can occur in either a plus (positive) or a minus (negative) direction, and are normally expressed as plus/minus values. If a platinum-resistance probe is used, the Probe Lead Error will always be in a plus direction. It must be taken out of the equation for Typical Error and added on (unsquared) outside the square root symbol.

Worst Case Error assumes that all the errors will occur in the same polarity direction, at the same time (the sum of their Absolute Values). This unique situation rarely, if ever, occurs in a "real world" system.

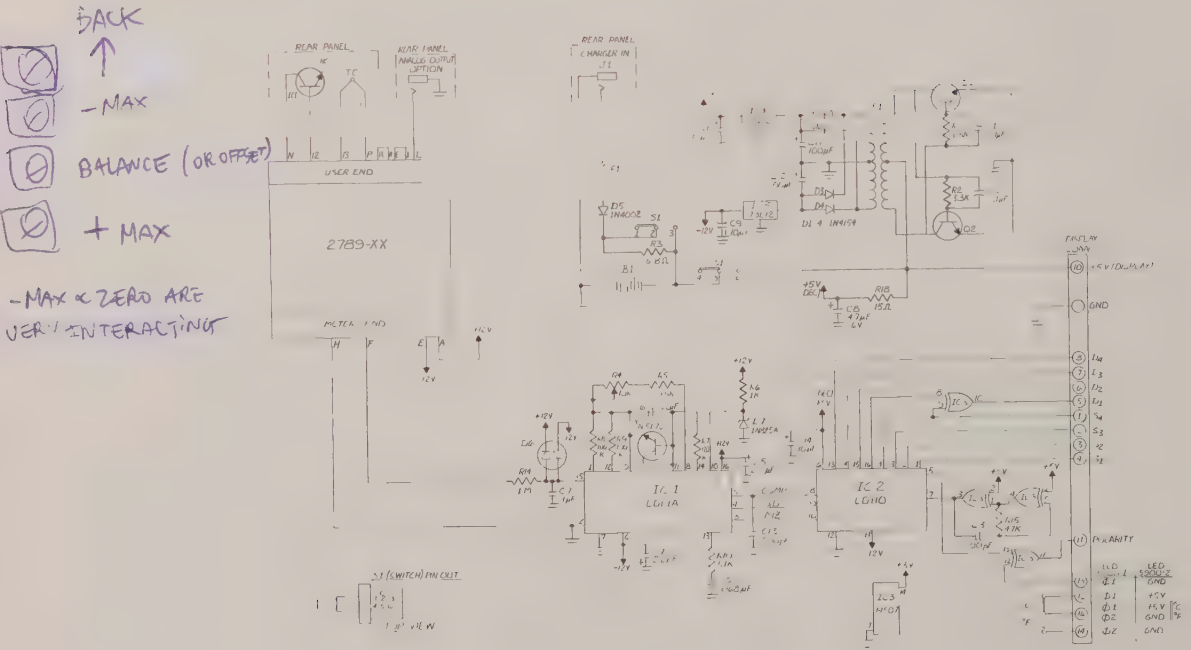
Typical Error accounts for the probability of the error occurring at times in opposite directions (one going positive while another goes negative). This consideration of subtraction or canceling effects provides a much more realistic value for total system error.

IMPORTANT

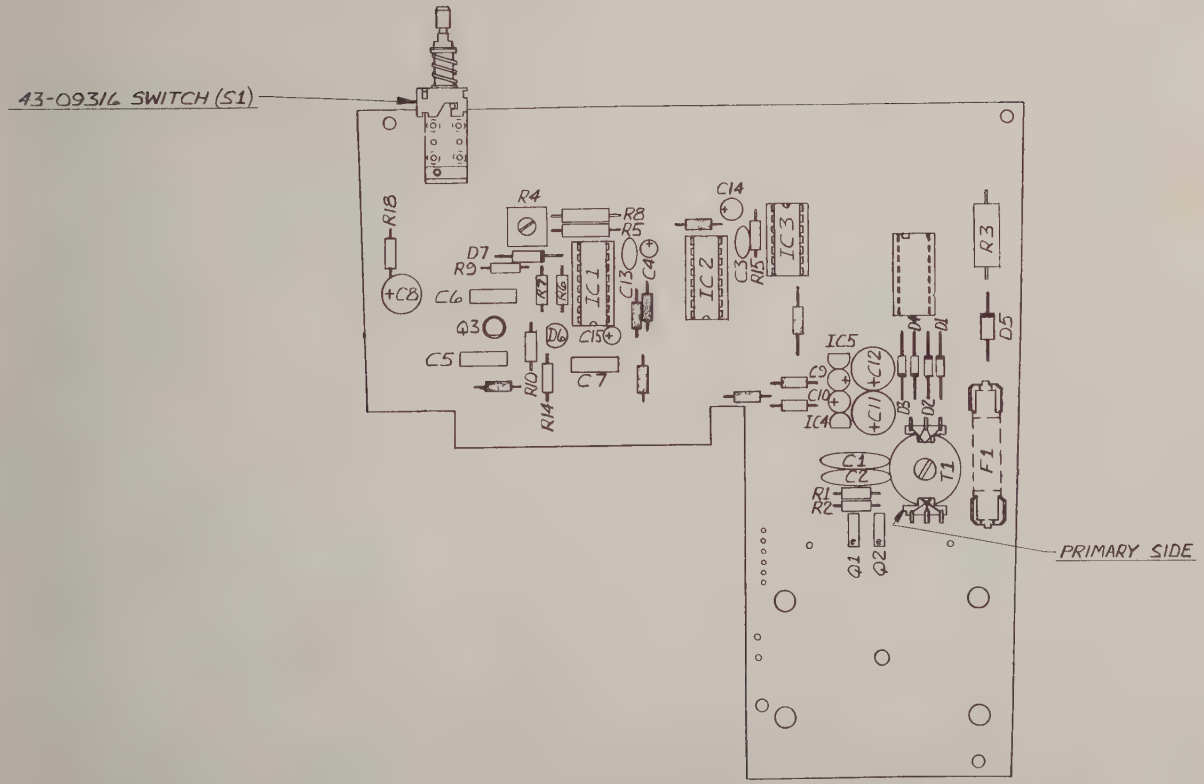
All of United Systems' instrument specifications are given as Worst Case values (the GREATEST amount of error that can occur, not the TYPICAL or average amount). This means that our specifications are the most extreme deviations that may occur, and that you can typically expect much better actual performance from your DigiTec instrument.

7. SERVICE INFORMATION

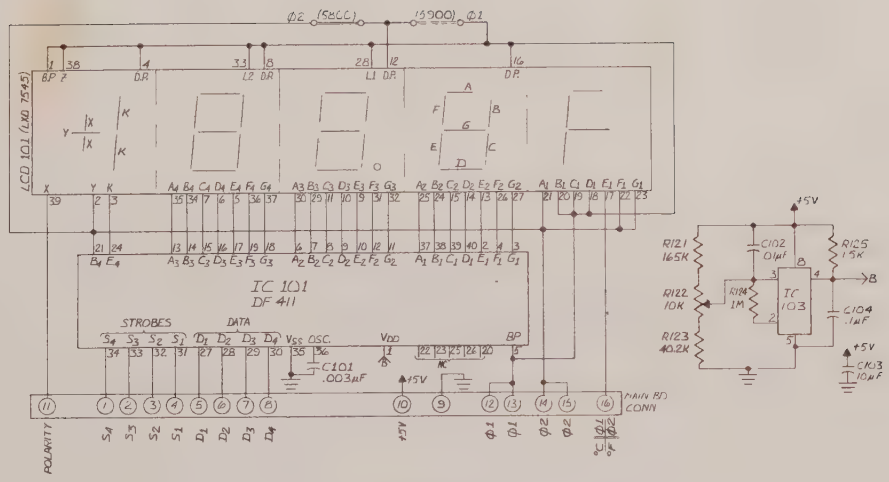
This section contains schematics, parts location pictorials and parts list to assist those who are technically qualified to use this information.



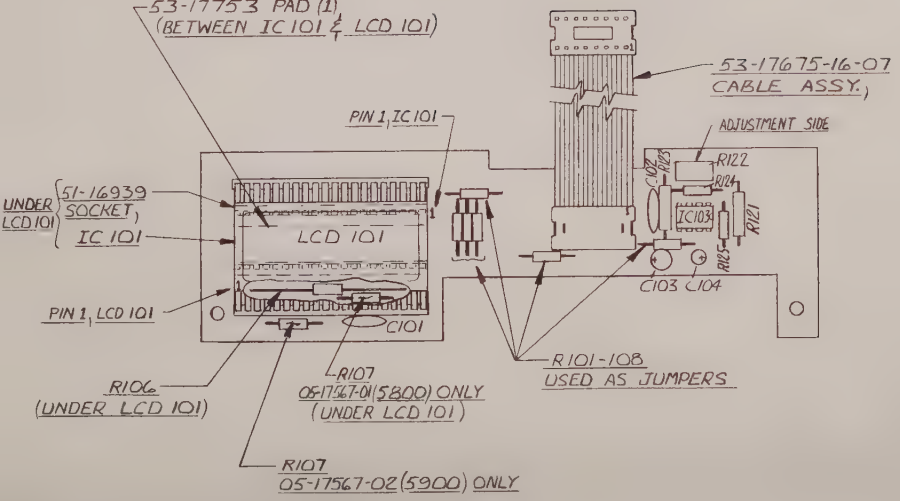
Main Board Schematic



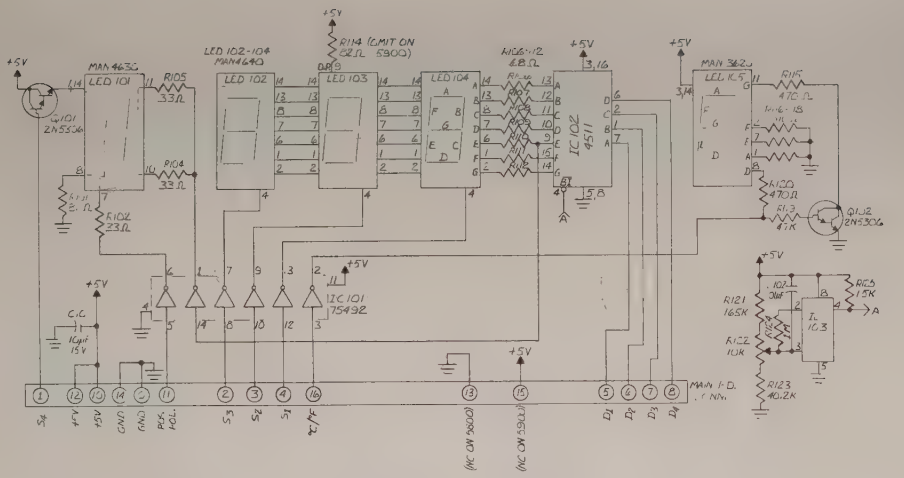
Main Board Pictorial



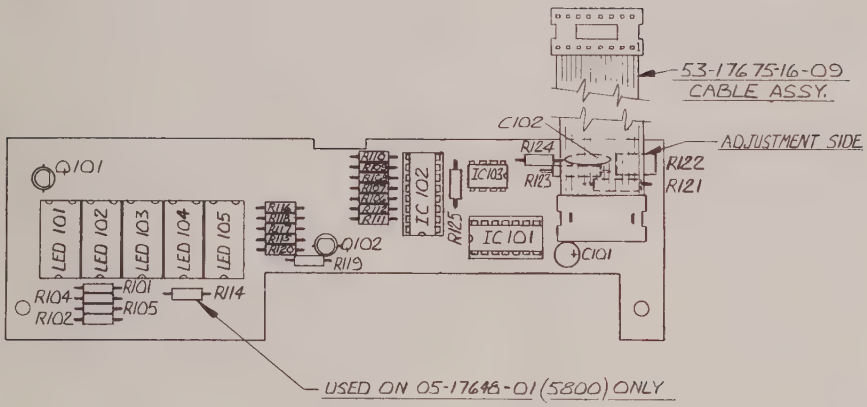
LCD Display Schematic



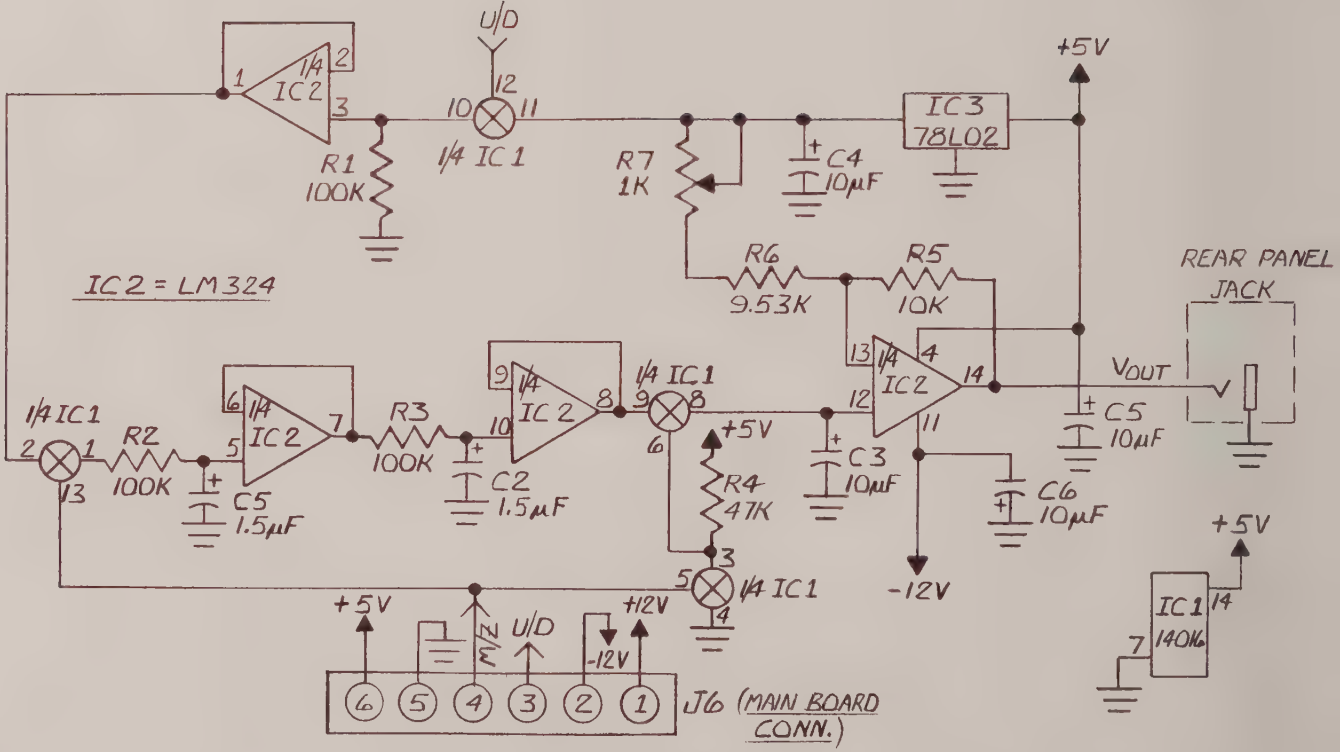
LCD Display Pictorial



LED Display Schematic



LED Display Pictorial



Option "R" Schematic

PARTS LIST

The following parts list contains the electrical (and some mechanical) components of each subassembly of the Model 5900 Series portable thermometers.

Under DESCRIPTION, the *type* of each capacitor and resistor is given by these codes:

CAPACITORS
A = Aluminum
C = Ceramic
E = Electrolytic
M = Mica
P1 = Polyester
P2 = Polysterene
P3 = Metalized Polycarbonate
T = Tantalum

RESISTORS
C = Carbon
F = Film
V = Variable
W = Wire-wound

MAIN BOARD

REFERENCE	DESCRIPTION	USC PART NO.	VENDOR
Complete Assembly		02-05900-01	USC
C1, 2	C, 0.01μf, 1000V	56-10215D103KT10	Centralab, DD Series
C3, 13	C, 500pf, 1000V	56-10215F501JC10	Centralab, DD Series
C4, 15	T, 2.2μf, 16V	56-12731A225N16	Siemens, B45134
C5	P1, 0.068μf, 250V	56-16873-683H2R5	Siemens, Type MKH
C6	P1, 0.022μf, 250V	56-16872-223H2R5	Siemens, Type MKH
C7	P1, 0.1μf, 250V	56-16873-104H2R5	Siemens, Type MKH
C8	T, 47μf, 20V	56-12731K476N20	Siemens, B45134
C9, 10, 14	T, 10μf, 16V	56-12731E106N16	Siemens, B45134
C11, 12	E, 100μf, 25V	56-10203-107N25	Sprague, Type 503D
D1-4	1N4154	40-09297	Motorola
D5	1N4000 Series, 100PIV	40-07787-01	Fairchild
D6	E7062	40-16800	Siliconix
D7	1N825A	40-14859	Motorola

MAIN BOARD (continued)

REFERENCE	DESCRIPTION	USC PART NO.	VENDOR
IC1	LD111ACJ	40-16268	Siliconix
IC2	LD110CJ	40-16267	Siliconix
IC3	MC14507CP	40-15953	Motorola
IC4	F78L12AC	40-15325	Fairchild
IC5	MC79L12C	40-16798	Motorola
Q1, 2	2N6121	40-15323	Motorola
Q3	2N5172	40-11353	General Electric
R1, 2	C, 3.3kΩ, 1/4W	55-10101HK003R3	I.R.C., GBT-1/4
R3	C, 6.8Ω, 1W	55-101013HA006R8	I.R.C., GBT-1
R4	V, 10kΩ, 1/2W	55-13262JK010	Beckman, 72 PMR
R5	F, 71.5kΩ, 1/8W, 1%	55-10168EJK071R5	Dale, Type MFF
R6	C, 1kΩ, 1/4	55-10101HK001	I.R.C., GBT-1/4
R7	C, 120kΩ, 1/4W	55-10101HK120	I.R.C., GBT-1/4
R8	F, 100kΩ, 1/8W, 1%	55-10168EJK100	Dale, Type MFF
R9	C, 100kΩ, 1/4W	55-10101HK100	I.R.C., GBT-1/4
R10	C, 51kΩ, 1/4W	55-10101HK051	I.R.C., GBT-1/4
R14	C, 1MΩ, 1/4W	55-10101HM001	I.R.C., GBT-1/4
R15	C, 47kΩ, 1/4W	55-10101HK047	I.R.C., GBT-1/4
R18	C, 15Ω, 1/4W	55-10101HA015	I.R.C., GBT-1H4
S1	Switch	43-09316	Centralab, PB Series
T1	Transformer	42-16982	USC
REAR PANEL		31-17654	USC
B1	Battery	48-17477	SAFT, B16510-4
Fuse	3/4A, Slo-Blo	52-09308-10	Buss
FRONT PANEL		31-17631-01	USC
Jack, Miniature,	J3	51-17594	Switchcraft, 142A
Button	Red	43-09078-C02	Centralab, J52305

DISPLAY BOARD (Model 5900-1)

REFERENCE	DESCRIPTION	USC PART NO.	VENDOR
Complete Assembly		05-17567	USC
C101	C, 0.003μf, 1000V	56-10215B302KT10	Centralab, DD Series
C102	C, 0.01μf, 500V	56-10215B103KYR5	Centralab, DD Series
IC101	DF411	40-17537	Siliconix
IC103	ICL8211CPA	40-17903	Intersil
LCD1	LXD 7545	40-17383	Liquid Xtal Displays
R101-107	C, 10Ω, 1/4W	55-10101HA010	I.R.C., GBT-1/4
R121	F, 165kΩ, 1/8W, 1%	55-10168ELK165	Dale, Type MFF
R122	V, 10kΩ, 1/2W	55d13261JK010	Beckman, 72XWR
R123	F, 40.2kΩ, 1/8W, 1%	55-10168ELK040R2	Dale, Type MFF
R124	C, 1MΩ, 1/4W	55-10101HM001	I.R.C., GBT-1/4
R125	C, 1.5kΩ, 1/4W	55-10101HK001R5	I.R.C., GBT-1/4

DISPLAY BOARD (Model 5900-2)

Complete Assembly		05-17648-1	USC
C101	T, 10μf, 16V	56-12731E106N16	Siemens, B45134
C102	C, 0.01μf, 500V	56-10215B103KYR5	Centralab, DD Series
IC101	75492A	40-15962	Fairchild
IC102	MC14511CP	40-16799	Motorola
IC103	ICL8211CPA	40-17903	Intersil
LD102-104	MAN 4640	40-16866	Monsanto
Q101, 102	2N5306	40-09277	General Electric
R101, 114	C, 82Ω, 1/4W	55-10101HA082	I.R.C., GBT-1/4

DISPLAY BOARD (Model 5900-2 cont'd)

REFERENCE	DESCRIPTION	USC PART NO.	VENDOR
R102, 104, 105	C, 33Ω, 1/4W	55-10101HA033	I.R.C., GBT-1/4
R106-112	C, 68Ω, 1/4W	55-10101HA068	I.R.C., GBT-1/4
R115, 120	C, 470Ω, 1/4W	55-10101HA470	I.R.C., GBT-1/4
R116-118	C, 510Ω, 1/4W	55-10101HA510	I.R.C., GBT-1/4
R119	C, 47kΩ, 1/4W	55-10101HK047	I.R.C., GBT-1/4
R121	F, 165kΩ, 1/8W, 1%	55-10168ELK165	Dale, Type MFF
R122	V, 10kΩ, 1/2W	55-13261JK010	Beckman, 72XWR
R123	F, 40.2kΩ, 1/8W, 1%	55-10168ELK040R2	Dale, Type MFF
R124	C, 1MΩ, 1/4W	55-10101HM001	I.R.C., GBT-1/4
R125	C, 1.5kΩ, 1/4W	55-10101HK001R5	I.R.C., GBT-1/4

ANALOG OUTPUT OPTION

C1, 2	T, 1.5μf, 25V	56-12731A155N25	Siemens, B45134
C3, 6	T, 10μf, 25V	56-12731F106N25	Siemens, B45134
C4, 5	T, 10μf, 6.3V	56-12731C106N06R3	Siemens, B45134
IC1	MC14066BCP	40-14752	Motorola
IC2	LM324N	40-16665	National Semiconductor
IC3	MC78L02CP	40-17821	Motorola
R1-3	C, 100kΩ, 1/4W	55-10101HK100	I.R.C., GBT-1/4
R4	C, 47kΩ, 1/4W	55-10101HK047	I.R.C., GBT-1/4
R5	F, 10kΩ, 1/8W, 1%	55-10168ELK010	Dale, Type MFF
R6	F, 9.53kΩ, 1/8W, 1%	55-10168ELK009R53	Dale, Type MFF
R7	V, 1kΩ, 1/2W	55-13261JK001	Beckman, 72XWR
Jack	Subminiature	51-16686	Switchcraft, TR-2A
Plug	Subminiature	51-16687	Switchcraft, 880

WARRANTY

UNITED SYSTEMS CORPORATION warrants each instrument and other article of equipment manufactured by USC to be free from defects in material and workmanship, when subjected to normal use and service. This warranty is expressly limited to the servicing and/or adjusting of USC supplied equipment (i.e. USC is not liable for damage to customer supplied equipment interfaced with USC equipment) returned, freight prepaid, to the factory or to the nearest factory authorized service center within one year from date of delivery; and to the repairing, replacing or adjusting of parts (excepting lamps, fuses, batteries, probes and electro-mechanical assemblies) which upon examination shall be found defective. This warranty shall not apply to any instrument or other article of equipment which has been repaired or altered outside of USC factory or authorized service stations nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation of use not in accord with instructions furnished by the manufacturer.

Material on electro-mechanical assemblies is warranted for 1 year from the date of delivery while labor is warranted for 90 days from the same date.

This warranty is expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and UNITED SYSTEMS CORPORATION neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products beyond that specifically provided hereinabove.

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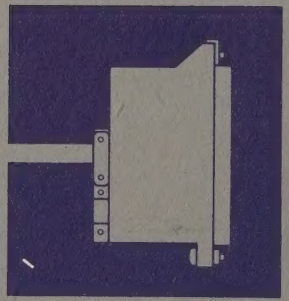

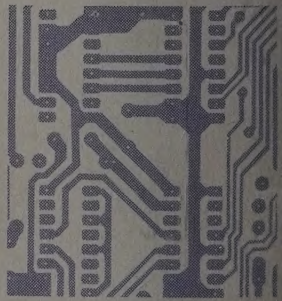

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